Microscopically the results of the process in our case was seen to be the same as those in progressive muscular atrophy, namely, destruction of the muscle by inflammation as well as by degenerative processes. While last year, in our paper on pseudo-hypertrophy, we took occasion to express surprise at the complete similitude between the results of the microscopical examination in that case and those obtained by Friedreich[1] in a case of spinal progressive muscular atrophy, we this year must call attention to the great analogy presented microscopically by our case of a year ago, with the one of to-day. Without again entering upon the details of either case, we beg to note the following quotations from the paper on Pseudo-hypertrophy. "I am convinced that in my patient the disease is essentially a chronic inflammation invading both the perimysium and the muscle fibre." "I may here say that I cannot agree with Gowers and Buss, that the proliferation of connective tissue is the primary, and the disease of the muscular tissue is the secondary process. Either the reverse of this is true or the process occurs simultaneously both in the muscle and the perimysium."[2] These citations sufficiently show the similarity of the findings in the two cases. From the arguments here adduced we can come to no other conclusion than that in this case of polymyositis progression we are dealing with a form of primary myopathy, closely allied if not identical with some forms of primary progressive muscular atrophy.

The following paper was read:

PROGRESSIVE MUSCULAR DYSTROPHIES: THE RELATION OF THE PRIMARY FORMS TO ONE ANOTHER AND TO TYPICAL PROGRESSIVE MUSCULAR ATROPHY.[3]

BY B. SACHS, M D.

The diseases to be discussed in this article have passed under so many different names that it will be necessary, first of all, to state what shall, and what shall not, be understood by the term "Progressive Muscular Dystrophies."

[1] *Friedreich*, Loc. cit., case 1c, p. 37.

[2] *Jacoby, G. W.*, Microscopical studies in a case of pseudo-hypertrophic paralysis, Journal of Nervous and Mental Disease. Vol. XIV., 1887, Sept., Oct.

[3] This article, with full references, was published in the *N. Y. Medical Journal*, December 8 and 15, 1888.

This term is intended to designate those forms of disease in which a primary progressive wasting of some or all of the muscles of the body is the most characteristic feature, and in which this wasting (atrophy) may or may not be associated with true or pseudo-hypertrophy of some muscles. These primary progressive dystrophies are our chief concern ; we have nothing to do with muscular atrophy following cerebral, myelitic, or peripheral nerve disease. One form of disease, however, which is undoubtedly due to changes in the spinal cord we must draw into the discussion. I refer to the typical progressive muscular atrophy. This must, in fact, be the basis upon which our discussion shall proceed, for a very large number of the cases and different forms of disease which we shall have to consider, were once classed under this term. "Progressive muscular atrophy" was for many years, and with many authors still is, a mere clinical designation, just as locomotor ataxy was a mere clinical term until the pathological anatomy of the disease was established, and the term was finally restricted to cases of tabes dorsalis.

Duchenne distinguished two forms—progressive muscular atrophy of the adult, and progressive atrophy of infancy. The latter will come up for consideration together with the new type of muscular atrophy which Landouzy and Déjérine have described and advocated. The former type remains almost in all particulars as Duchenne described it. Modern authors, including Charcot, Leyden, Strümpell, Hammond, Gowers, and others, have been able to add but very little to Duchenne's original description. The chief characteristics of this form are as follows :

Progressive Muscular Atrophy (type Aran-Duchenne).— This form begins in a large majority of cases with an atrophy and corresponding weakness in the small muscles of the hand (thenar and hypothenar). The atrophy spreads from muscle to muscle ("atrophie individuelle"). Beginning as a rule with the adductor pollicis longus, it involves next in order the opponens pollicis and deep muscles of the thenar ; from these it extends to the hypothenar, the interossei, the flexors and extensors in the forearm. At this

stage the disease may remain stationary or it may spread to
the flexors in the upper arm, to the deltoid, possibly the
triceps, and finally to the muscles of the trunk, the shoul-
ders, and the back.   Duchenne recognized the fact that the
atrophy may begin in exceptional cases in the trunk, in the
shoulders, or in the legs. Certain it is that in those cases
in which the atrophy begins in the hands, the legs are not
affected until very late in the course of the disease. One
marked exception to this rule has occurred in my own prac-
tice in the case of a woman aged 40, in whom the atrophy
attacked almost simultaneously the small muscles of the
thenar and the anterior muscles of the thigh. This case
had all the other symptoms of typical progressive muscular
atrophy.

The atrophied muscles in progressive muscular atrophy
exhibit fibrillar contractions and for a long time retain
their faradic contractility. There may be a diminution of
faradaic or galvanic excitability proportionate to the wast-
ing of some muscles, and a complete or partial reaction of
degeneration may be present in other muscles. The march
of the disease is steadily progressive. Heredity is a strong
factor in the disease, as is shown by the remarkable series
of cases published by Naunyn and Eichhorst in the *Berliner
klinische Wochenschrift,*and by the account of the Weathers-
bee family given in the later editions of Hammond's treatise,
although the latter cases probably belong to the peroneal
type to be discussed later on.   Osler's cases also give
strong proof of heredity.

With the exception of the factor of heredity, all the
clinical features as given above were known to Duchenne.
For many years, too, the clinical features of progressive
muscular atrophy were beyond question. All discussions
that followed related to the question whether this disease
was of spinal or peripheral origin. Duchenne first regarded
the disease as of peripheral origin, but in his third edition
retracted this view, convinced, as he says, by the patho-
logical and anatomical facts gathered by Charcot and
Joffroy, Lockhart Clarke, Hayem, and others.   To
Clarke, and above all to Charcot and his school, we owe

the advances made (in the years 1860 to 1870) in our knowledge of the pathology of progressive muscular atrophy.

The main changes found are these : a sclerotic and pigmentary atrophy of the ganglion cells of the anterior horns ; inflammatory changes in the neuroglia ; increased size of the blood-vessels, and proliferation of the cellular elements. In fresh preparations granular corpuscles are found, and according to the degree and stage of the disease the anterior gray cornua are reduced in all diameters, and the ganglion cells either atrophied or entirely lost. The anterior nerve roots are affected secondarily to the lesion of the gray substance. The nerve fibres are not all destroyed, a number of them remaining intact. Those that are destroyed exhibit the appearances of simple atrophy—a point to which Charcot alludes as distinguishing these cases from infantile spinal paralysis.

The theory of the disease was and is, that the inflammation spreads slowly from the ganglion cells of the anterior horns along the anterior nerve roots, without destroying as many of these fibres as is the case in infantile poliomyelitis. The atrophic changes in the muscles are, on this hypothesis, the direct result of the irritation which begins in the cells of the anterior horns and is propagated thence through normal or only half wasted nerve roots to the peripheral muscular fibre.

The earlier pathological investigations erred in various respects ; first of all that changes in the spinal cord were not noted, the white columns of the cord were not carefully examined ; in consequence of this inadvertence in the examination of pathological specimens and on account of insufficient clinical description many cases of amyotrophic lateral sclerosis were recorded as cases of progressive muscular atrophy. It is Charcot's great merit to have done pioneer work in this, as in so many other neurological problems. In France, Charcot succeeded in making his *tephro- (polio-) myélite chronique parenchymateuse* the anatomical substratum of Duchenne's progressive muscular atrophy.

From this time onward, German investigators play a
very important rôle in the solution of the problem under
discussion, attacking the problem both from the patho-
logical and from the clinical standpoint. Bamberger and
Recklinghausen published two cases of Duchenne's
atrophy in which no changes could be found in the spinal
cord post-mortem, but it was not until the appearance of
Friedreich's great monograph that the possible periph-
eral origin of progressive muscular atrophy was again
pushed into the foreground.

Friedreich claimed that the changes found in the ante-
rior nerve roots and in the anterior cornua, in cases of
progressive muscular atrophy, were secondary changes,
and to this he allowed no exception. According to Fried-
reich's views, progressive muscular atrophy is a primary
chronic myositis which is followed in due course of time by
secondary changes in the nervous system. The inter-
muscular nerve filaments are the first to be affected, and
from these nerve filaments an ascending neuritis travels
along the peripheral nerve trunk to the anterior roots of
the spinal cord segment; the neuritis of these anterior
nerve roots may spread to the cord and here set up chronic
myelitic changes which will vary greatly in degree and
distribution; the extent and character of the changes will,
according to Friedreich, depend upon the extent of the
muscular affection. The changes in the peripheral nerve
fibres and in the ganglion cells of the anterior horns are the
result of the impaired motor functions of the affected mus-
cles (op. cit., p. 118 and 124).

On this theory alone, Friedreich insisted, can we explain
why in certain cases a widespread muscular atrophy is
associated with changes in the cervical segment only, as in
the cases of Dumenil, of Lockhart Clarke and Gaird-
ner, in the cases of Clarke and Cooper, Clarke and
Johnson, and others, in which changes were found in
the spinal cord, and none in the nerve roots. Friedreich
claims that the nerve roots were not properly investigated;
on the other hand, the cases of Recklinghausen, of Fried-
reich and Cruveilhier, of Trousseau and his own cases

(Nos. 4 and 21), proved to *him* that changes may occur in the muscles themselves, or in the nerve trunks and anterior nerve roots, and not in the spinal cord ; but Charcot (op. cit., p. 209,) very correctly protests that all these cases upon which Friedreich's proof rested were examined before the present successful histological methods for staining the spinal cord had come into vogue, and that they, therefore, prove nothing.

While Friedreich's judgment unquestionably erred in regard to many of these cases, the error can be explained, since many of the cases upon which he based his views are now known to belong to other forms of muscular atrophy in which there is *no* accompanying change in the spinal cord. As regards typical progressive muscular atrophy the investigations of later years have put the spinal origin beyond question, although as Schultze has shown in his excellent monograph there are but two cases of Duchenne's atrophy (cases of Pierret-Troissier and of Strümpell in which the anterior gray matter was the *only* part affected and alone responsible for the widespread muscular atrophy. To this last we might add the case of Wood and Dercum, if the clinical history were not unsatisfactory. Schultze arrives at his conclusions by excluding even those cases in which the nuclei of the medulla had become involved by extension of the process. Without wishing to depart from the subject before us, I may intimate that these pathological researches prove that although progressive muscular atrophy is of spinal origin, and is a distinct clinical entity, it is not necessarily a morbid entity, and in most cases represents an early stage of one of several spinal cord diseases.

It is now time to retrace our steps and note the development of our knowledge regarding pseudo-hypertrophic muscular paralysis.

The history of this form can be related in few words. The clinical features as laid down by Duchenne, Griesinger, Seidel, and others have been universally accepted. These authors and all who followed them fastened upon the increase in the size of some muscles as the characteristic

symptom of the disease, and have largely disregarded the widespread muscular atrophy which is present in many cases of pseudo-hypertrophy.

The earliest cases of pseudo-hypertrophy of muscles were described by Meryon in 1852. Similar cases had been described by Charles Bell in 1830, but were not valued at their true worth, and Meryon even claimed that his cases were intimately related to Cruveilhier's (Aran-Duchenne's) atrophy. Oppenheim in 1855 published a thesis at Heidelberg on progressive muscular atrophy in which he reported a number of cases of pseudo-hypertrophy, without, however, making a distinction between these cases and Duchenne's type. It was Duchenne again who, in a paper (22) published in 1861, first called attention to the increase in the volume of certain muscles as the important feature in the disease, and in his "Electrisation localisée" established this type of disease for all times. Since that time innumerable cases have been published, enabling Gowers in 1879 to base his studies upon a series of 220 cases; some of these, however, evidently belonging to other categories. The clinical features have been verified so many times over that we need not in this paper analyze all the cases, but can without hesitation present the general features of the disease.

Pseudo-Muscular Hypertrophy, or pseudo-muscular sclerosis (Jaccoud), atrophia musculorum lipomatosia (Seidel) is a disease of early youth, the vast majority of cases beginning before the age of six. Boys are affected somewhat more frequently than girls, and there is good proof of heredity. The disease, although largely affecting boys, being most frequently inherited through the mother. Meryon's cases appeared to form an exception (vide Gowers, op. cit., p. 24). The first symptoms are a weakness in the muscles of the leg, a waddling gait, and an apparent increase in the size of some of the muscles of the leg. In many cases the calves only are hypertrophied, in others the calves and thighs, and in rarer cases, like one now under my observation, the disease is limited to, or at least begins in, the thigh muscles.

Author's Case I.: (Pseudo-Hypertrophy).—A.K.,aged 10; mother has six children ; one died of "brain fever," and one of croup. Four living ; one older than patient; all healthy. No history of heredity. Patient, a stout child, a newsboy, had first teeth at four months ; when one year old began to walk. At one and a half years showed weakness and could not walk alone, was provided with some sort of machine with which he learned to walk. Was treated for rickets. Youngest sister has distinct rickets at present. No change until last December, when parents noticed that he was getting lamer. Mother states that thighs were always large ; had difficulty in finding trousers that would fit the boy in the thighs. Boy could never walk as other children did and could never run after others. He now complains of great fatigue and when walking throws himself down on the grass from mere fatigue. Examination shows increase of volume of anterior thigh muscles of both sides, most marked in the middle portion of the vasti. Calves not hypertrophied ; no other atrophy anywhere except in the serratus anticus of the right side. Grasp of both hands normal ; knee jerks present; all electrical reactions normal. With the assistance of Dr. Peterson I excised two pieces of muscle from the left vastus externus, which will be referred to in a later section of this paper. The wound healed readily, boy complains of greater weakness in the leg from which pieces of muscle were removed.

Duchenne made out three stages of the disease. In the first, difficulty in standing and walking, and weakness of muscles of lower extremities and of sacro-lumbar region. In the second stage the hypertrophy becomes the prominent feature, spreading to various muscles of the body, and in the third stage there is increased feebleness of the muscles of upper and lower extremity of the trunk. Other authors recognize a weakening of the sacro-lumbar region and in a general way a weakness of the upper extremities, but in view of Erb's recent studies it is due to Gowers to state that he called attention to the fact that in many cases of pseudo-hypertrophy the "infraspinati and deltoids are

often increased in size. . . . The latissimus dorsi is commonly much wasted, and so also is thé lower (sterno-costal) portion of the pectoralis major. . . . The fore-arm muscles are rarely affected."

To complete the clinical picture we must in addition refer to the lumbar lordosis (probably due to the weakness of the extensors of the hip), to the occasional presence of contractures, and to the peculiar difficulties in rising from the ground (the patient climbing up upon himself) which are present in some cases, but not necessarily in all, and to which Gowers attaches too much importance in making it the cardinal symptom of the disease. My patient has distinct pseudo-hypertrophy, but rises from the floor with the greatest ease. In a general way it is to be noted that there are no fibrillar contractions in the affected muscles, no changes in the electrical reaction, except diminished excitability to both currents, no sensory disturbances, and the patellar reflex may or may not be present. As a typical example of pseudo-hypertrophy and for some special reasons I will cite the following case now under my observation :

Author's Case II.—M. K., girl, aged 12½ ; mother has one other child living and healthy. One son died at age of 24 of meningitis. Patient first seen by me two years ago. History showed that child had severe fright at age of ten months. Child has always been very nervous ; learned to stand and walk at usual age, but had diphtheria at age of four, since when the disease has become much worse. Legs first grew thin. The calves increased in size about four years ago. Child has always had characteristic difficulty in walking and rising from the floor. Examination shows decided weakness in posterior group of leg and thigh muscles ; calf and thigh muscles distinctly hypertrophied. Nerves and muscles of lower legs react well to faradic current, much more readily on indirect than direct excitation. No atrophies anywhere in the body, none around shoulder girdle, hands normal. Child has difficulty in getting upon a chair and in descending comes down with a bound.

Thigh, left, $13\frac{10}{16}$ inches ; right, $13\frac{3}{16}$ inches.

Calves, left, $10\frac{1}{4}$ inches ; right, $10\frac{4}{16}$ inches.

Examined the child again after two years ; found condition very much the same. Thighs, left side, 16 inches ; right, $15\frac{1}{2}$. Calf, left side, 11 inches ; right, $10\frac{1}{2}$, showing that the growth of the calf muscles has not kept step with the growth of thigh muscles. Muscles of calf and anterior thigh muscles still appear large. Resistance to passive movements very much diminished, particularly in extensors of thighs. Atrophy of sternal portion of the sterno-cleido-mastoid, left shoulder stands out more prominently than right, but shows no hypertrophy. All arm and forearm thin, distinct atrophy in the muscles of the interosseous spaces, grasp very weak, right 18, left 18. In walking, both feet assume valgus position. Arms are in marked contrast to legs. Length of arms, 25 inches ; length of legs, 28 inches. Electrical examination : All muscles respond promptly to faradic current, except interossei and vasti of both sides, which require very strong currents. Galvanic response diminished in interossei and in muscles of thenar, but formula not altered.

Having agreed to accept the foregoing description and histories as typical of what is ordinarily called pseudo-muscular hypertrophy, we must now devote a little more attention to the pathological anatomy of the disease. Cases of pseudo-hypertrophy with autopsies are relatively few, and for that reason the evidence must be carefully sifted.

Middleton, in his very carefully prepared paper, collected seventeen cases of pseudo-hypertrophies with autopsies; one of these must be excluded from the list as being a clear case of amyotrophic lateral sclerosis. Schultze (op. cit ., p. 36,) has added to this list the two cases of Middleton, one by Berger, two cases described by Günther, one by Pick, and one by Friedreich (op. cit., p. 347), making twenty-three cases in all.

Of these twenty-three cases, those of Friedreich, Meryon (case 2), Kesteven, Baeg, Brigidi, Ross (case 1), and of Günther must be excluded, either because the spinal cord

was not examined microscopically or because the examination was not properly made. Of the fifteen remaining cases, *the spinal cord and anterior nerve roots were found absolutely normal* in ten, and in five others the changes that were found could not be held responsible for the changes in the muscles. These ten cases are unobjectionable in every point; their clinical histories are very similar in every respect and are sufficient proof of the fact that pseudo-hypertrophy of the muscles is *not* dependent upon changes in the spinal cord.

In the endeavor to increase this list, I have carefully searched for earlier cases with autopsies, in our own literature in particular, which might have escaped Schultze's notice, and have furthermore endeavored to collect cases which have appeared since the publication of Schultze's monograph, but the total increase is not great.

First of all, attention should be directed to Gibney's case, which was presented to the American Neurological Association two years ago. The history of the boy, aged 16 at death, who had been under observation for ten years, is a typical one of the disease. There was first distinct enlargement of the calves, followed later on by atrophy. A brother is affected in the same way. Dr. Amidon, who examined the cord, reports: "The only lesion appeared to be in the ganglion cells of the anterior horns. . . . About one-half of the cells seemed to have disappeared, leaving no trace. The remaining ones are poorly defined, small, and in many instances processless. . . . Lesion more marked in the dorsal than in lumbar region."

Through the kindness of Dr. Amidon, I have been permitted to re-examine the specimens, and I hope he will permit me to say that the case may be used to show that there are no *serious* cord changes in pseudo-hypertrophic paralysis. Processless ganglion cells mean as little in the spinal cord as processless pyramids mean in the cortex ; and a diminution in the relative number of cells in any one section is a point exceedingly difficult to determine, and, if present, is more apt to be a secondary than a primary affair.

I hope that both Drs. Gibney and Amidon will agree to this view of their case.

The only other cases of pseudo-hypertrophic paralysis *with autopsies* which I have been able to find, were these : Westphal reported the cases of two sisters, both affected with pseudo-hypertrophy, in the one case characterized by unusual increase in the volume of many muscles. Westphal found *no changes whatever either in the cord or in the peripheral nerves.* Coming from so distinguished an author, these facts deserve the greatest consideration.

Middleton has described another interesting case with enormous pseudo-hypertrophy and a wide-spread atrophy, including even the masseters ; but the cord did not harden well, and a microscopical examination could not be made. The case is, therefore, useless for our present purposes.

Further autopsies on typical cases of pseudo-hypertrophy are extremely desirable ; but Westphal's cases, together with the others analyzed above, place the non-spinal origin of pseudo-hypertrophy beyond question.

These facts do not appear to be properly appreciated as yet, for we find that Dr. Inglis very recently reports several cases of pseudo-hypertrophy, and assuming that all pathologico-anatomical facts point to the spinal cord as the seat of the disease, Dr. Inglis gets over the discomforting negative facts by stating that " the cases in which the post-mortem examination shows the cord visibly intact do not invalidate this idea (the spinal origin of pseudo-hypertrophy) ; and that the defect in the distal ends of the motor fibres, while not in every case accompanied by atrophy of the central cells, is yet the indication of an impaired activity of those cells."

It is more surprising still to find Hammond disregarding the evidence of the last ten years, and adhering to the spinal theory of pseudo-hypertrophic paralysis, and even going so far as to entitle the disease " pseudo-hypertrophic *spinal* paralysis." Hammond's conclusions are based on cases of Barth (40), Müller, and Lockhart Clarke. Barth's case is one of amyotrophic lateral

sclerosis; Muller's case was complicated by cerebral disease, and therefore useless for the determination of the anatomical lesion; while Lockhart Clark's case showed changes which are not primary, and which Gowers, whose case this was, acknowledged (in the *Lancet* for 1879) to have been possibly due to the paralysis of long standing and to the frequent pulmonary troubles.

At this stage of our studies let us note that careful clinical investigation and post-mortem examinations have shown, among other facts, that a wide-spread atrophy is common to progressive muscular atrophy, type Aran-Duchenne, and pseudo-hypertrophy; but that the absence of all changes in the central nervous system, the absence of fibrillar contractions, and the absence of reaction of degeneration, in cases of pseudo-hypertrophy, separate it widely from the former disease. Later on we shall see that a very intimate relation exists, however, between pseudo-hypertrophy and certain other forms of muscular dystrophy which were formerly included under the general heading of Progressive Muscular Atrophy.

The process of distinguishing these forms from progressive muscular atrophy was of slow development, and with the steps of this process we shall become best acquainted by alluding to a few excellent articles published between the years 1870 and 1880.

Lichtheim was one of the first to take up the cudgels for Friedreich's theory of progressive muscular atrophy. In 1878 he published a paper on a case of "Progressive Muscular Atrophy without Disease of the Ganglion Cells of the Anterior Horns."

This case of Lichtheim was followed up by one of Erb and Schultze and one of Kahler. The former authors endeavored to disprove Lichtheim's case by a case of typical progressive muscular atrophy with changes in the cord. Erb's criticisms were quite severe, but they have lost all of their force since Schultze showed in later years that the changes which he and Erb found were not sufficient to account for the muscular changes, the cells that were atrophied being now known to be in no physiological con-

nection with the muscles that were atrophied ; and, further-more, Erb has since decided that Lichtheim's case, though a very important one, belongs to the type which Erb (34) first described a few years later. And to this most impor-tant class of cases we must now devote our attention.

Erb's Juvenile Form.—Erb described this new form of disease in his " Elektrotherapie," but sufficient attention was not paid to this juvenile form until Erb again called attention to it in a lengthy article on the subject published in 1884.

The following is a typical case of Erb's juvenile form, the history of which will bring out clearly enough the differ-ences of this form and typical progressive muscular atrophy.

Erb's Case I.—Male, aged 46. No hereditary history, no syphilis ; several acute diseases in childhood. At the age of 15 noticed that the right arm was weaker and thinner than the left. No pains or paræsthesiæ. Trouble did ·not grow worse until about the age of 40 ; at that time the legs and left arm became involved ; no sensory, vesical, or sexual disturbances.

Examination revealed changes in the following mus-cles :

Wasted : Both pectoralis major and minor, both trapezii, latissimus dorsi, serrati ant. maj., rhomboids with exception of upper portion of right rhomboid superior, both sacro-lumbalis and longissimus dorsi, deep neck muscles, levator anguli scapulæ right > left, brachialis anticus right > left, supinator longis (both sides), triceps right > left, gluteal muscles right > left, iliopsoas right > left, quadriceps, ten-sor fasciæ ; anterior leg muscles weak with exception of tibialis anticus ; abdominal muscles, diaphragm paretic.

Normal : Sterno-cleido-mastoid, levator anguli scapulæ, dexter, coraco-brachialis, flexors and extensors of forearm, thenar and hypothenar, adductors, flexors of leg, calf mus-cles, small muscles of foot.

Hypertrophied : Deltoid left > right, infraspinati mus-cles, both teretes.

Not ataxia ; patellar reflex present ; no fibrillar contrac-tions ; diminished electrical excitability of muscles, but no trace of reaction of degeneration.

The other cases of Erb resemble this one in every respect, except that in at least one of his patients a later examination revealed an incipient hypertrophy of the calves.

Erb has taken the trouble to hunt through the older literature and proves very conclusively that similar cases have been described by Aran, Duchenne, Friedreich, Ross, and others, either as cases of progressive muscular atrophy or of pseudo-hypertrophy. Erb thus summarizes the chief features of this juvenile form : It is a progressive wasting with weakness of certain groups of muscles, beginning either in childhood or early youth, involving as a rule the muscles of the shoulder girdle, the upper arm, the pelvic girdle, the thigh and the back ; the forearm and leg muscles remaining intact for a very long time. The atrophy may be associated with true or pseudo-hypertrophy of some muscles. Fibrillar contractions and reaction of degeneration are never present. No sensory or visceral disturbances. He adds that the wasting is distributed in a typical manner. The pectorals, trapezii, latissimi dorsi, the serrati, the rhomboids, as well as most of the upper arm muscles and supinators are apt to be wasted, while the deltoids, supra and infra-spinati are either normal for a long time or hypertrophied. The preservation, furthermore, of the hand and forearm muscles give a very striking clinical picture.

This disease Erb has chosen to call the juvenile form of progressive muscular atrophy—a very unfortunate term, since many of the cases exhibited no symptoms until the patient was well advanced in years, and others again began in early infancy. Erb's description has been accepted by Nothnagel, Schultze, Charcot, Eulenburg, Remak, Gowers, and many others.

Upon the exact distribution of the atrophy and hypertrophy as demonstrated by his cases, Erb lays the very greatest stress. According to his view, well-preserved forearms, atrophied upper arms, hypertrophied deltoids, and efficient scapular muscles would be almost sufficient for a diagnosis of his special form. In the lower legs an almost

analogous wasting occurs : thighs and glutei well wasted, while leg muscles and calves are well preserved.

The question arises, whether Erb did not attach too much importance to this exact topographical distribution of muscular atrophy and hypertrophy. He claims perfect identity between his juvenile form and pseudo-hypertrophy ; page 518 he says : "If this disease occurs in earliest childhood and is not associated with any considerable lipomatosis, the disease is what has been termed hereditary muscular atrophy. If it happened to be associated with early developed and excessive lipomatosis, particularly in the lower extremities, it is synonymous with so-called pseudo-hypertrophy." "But all of these forms are identical with one another and merely represent different manifestations, different march of the disease (Verlaufsweisen) and varying degrees of intensity of the same disease."

The relation to hereditary muscular atrophy I will discuss later on, but as for its relationship to pseudo-hypertrophy, is it not curious that Erb's form is so far less frequent than the ordinary pseudo-hypertrophy ? To be sure, this might be explained in a number of different ways. First, the accuracy of description has been at fault in many cases. Most authors have had the hypertrophy, and that only, in mind, and have not, with the exception of Friedreich and Gowers, paid much attention to the atrophy in the upper extremities ; and if detected, most authors have described the atrophy so poorly that a clinical picture such as Erb discovered cannot be made out from their description. This is true not only of older writers, but also of those that have written since the appearance of Erb's paper. I have analyzed all recent cases of pseudo-hypertrophy for the purposes of clinical differentiation, but in the fewest cases have even the functional motor disturbances been stated with sufficient clearness to permit an inference as to the wasting of certain muscles, and definite statements with regard to the atrophy of this or that muscle are entirely wanting in the majority of cases. I wish incidentally to remark that every case of pseudo-hypertrophy should be examined with the greatest care regarding the condition of

the upper extremities and the smallest amount of atrophy or hypertrophy of any muscle should be distinctly noted. I have found a slight change in the faradic response of symmetrical muscles a valuable hint in getting at an incipient wasting with corresponding paresis. Such a condition would, in at least one case, have escaped my notice if I had not examined both pectorals and had found that the one gave a much more lively response to the faradic current than the other did.

And yet, allowing for all these possible errors, an examination of American cases, for instance, has convinced me that Erb's juvenile form is very much rarer in this country than typical speudo-hypertrophy is. In England, Ormerod Ross and Dreschfeld are the only ones who have described cases resembling Erb's form, and Ormerod's case contains several atypical features. In this country none have to my knowledge been published as cases of Erb's juvenile form, though as Seguin has pointed out Mastin's cases of hereditary ataxia may be cases of Erb's form. I have not been able to get at the original paper of Mastin.

During the past two years I have waited patiently for an example of Erb's form to turn up, without, however, meeting with a single one. This disease may be as much less frequent in America, as the Landouzy and Déjérine type is less frequent in Germany than it is in France. Furthermore, the thought naturally occurs to one that Erb's special form may represent in many instances a late stage of pseudo-hypertrophy, and that the majority of cases of this disease dying at an early age never reach this stage. And yet we must not forget that Erb has described several cases of his typical form beginning at a very early age ; and, on the other hand again, we well know that cases of typical pseudo-hypertrophy may be associated with atrophy in the upper extremity, without this atrophy assuming Erb's characteristic distribution, as proved by my own case (M. K.) cited above.

In view of such cases as this one and the reasoning followed above, it seems to me that the topographical distribution of the atrophy or hypertrophy cannot be depended

upon to prove the close relationship between pseudo-hypertrophy and the juvenile form. And that for the present pseudo-hypertrophy deserves the rank of a special form. Their relationship seems to me, however, to rest upon several cardinal symptoms.

First. Upon a progressive wasting beginning in early life associated with hypertrophy at any time during the course of the disease.

Second. Upon the entire absence of fibrillar contractions.

Third. Upon the absence of the reaction of degeneration.

Fourth. Upon the absence of changes in the spinal cord, the autopsy in Lichtheim's case going to prove this last statement.

Fifth. Upon the occurrence of both forms in various members of a single family.

These cardinal symptoms several other forms of muscular atrophy have in common with the two forms just discussed.

We have now to turn our attention to another type, to the so-called hereditary form of progressive muscular atrophy. This type was created by Leyden and warmly advocated by Moebius. According to Leyden this form is characterized as follows:

The Hereditary form of progressive muscular atrophy attacks several members of the same family. It appears at an early age, as a rule between the eighth and tenth year, in one case not before thirty. Males are more apt to be attacked than females (the elder Eulenburg, however, described the affection in three sisters of one family). The disease begins invariably with weakness in the back and lower extremities and in these regions a wasting of the muscles is first observed. After a lapse of years the muscles of the upper extremities may be involved. Occasionally the patient may attain to an old age. Atrophy may become so extreme that the patients are absolutely helpless. The march of the disease is steadily progressive. Electrical reactions normal; no fibrillar contractions. The

atrophy is associated with hypertrophy, particularly of calf muscles.   No sensory disturbances, no disturbance of speech, of deglutition or ocular movements.

Leyden records the case of a man thirty-seven years of age, who had trouble in walking from early childhood on, and who had decided atrophy of back and thigh muscles, with vast increase of calf muscles, without any involvement of shoulder and arm muscles.   The general symptoms were of the kind stated above.   Leyden counted among this class of cases a well-known one of Meryon, the cases of Oppenheimer, Hemptenmacher, of Bernhardt and of Eichhorst; but all of these cases have been considered by most other and later authors to belong to the type of pseudohypertrophy.   Leyden has been followed by Moebius, by Zimmerlin, by Landouzy and Déjérine, by Schultze, and others, in the description of this type ; but of these Moebius and the French authors alone can be said to be advocates of this special form.

In my opinion, there is not sufficient reason to create a separate type of disease on the points laid down by Leyden. First, all forms of muscular atrophy may be and often are hereditary. This is particularly true of pseudo-hypertrophy. Second, cases with distinct heredity often start in the upper extremities, and, third, all cases beginning with weakness and atrophy in the back and leg muscles are not necessarily hereditary, as we shall see when we come to the consideration of the peroneal type of progressive muscular atrophy.

As regards the first point, in the cases of Oppenheim, Freidreich, and Hemptenmacher, the disease began in the muscles of the back, but spread to the upper extremities instead of the lower.   Barsikow has described a number of cases occurring in two families.   In the members of one family the disease attacked the back and leg muscles, in the other family the spreading of the atrophy was not uniform, attacking the leg muscle in one member and in another the shoulder first and then the leg muscles.

Zimmerlin (loc. cit.) published seven cases, four in one family and three in another.   In one family the four

cases are distinctly of the juvenile type, while in the second family the two cases began in the upper extremities, leaving the legs intact, while in the third case there was involvement of upper and lower extremities and even involvement of face muscles—an approach to the type Landouzy-Déjérine.

Schultze (loc. cit.) describes the cases of two brothers, one affected with typical pseudo-hypertrophy, and the other with a general wasting of the upper and lower extremities. In this country, Harrington has reported seven cases, in which the onset was in the legs in some, in others in the legs and arms simultaneously, and in still others the legs were affected first, and only a year later the arms. Ormerod's cases of muscular atrophy in three children after measles, might be used to show the same differences in the mode of onset.

We have therefore good reason for insisting that Leyden's hereditary form is not entitled to rank as a special type of progressive muscular atrophy; that pseudo-hypertrophy and Erb's juvenile form are distinctly hereditary, and furthermore that cases with a distinct heredity are by no means necessarily characterized by an atrophy first attacking the muscles of the back and thighs. All of Leyden's cases would properly come under the head of pseudo-hypertrophy or of Erb's juvenile form, and the peroneal type.

The next type of progressive muscular atrophy, the type fascio-scapulo-humeral, type Landouzy-Déjérine, the infantile progressive muscular atrophy of Duchenne, cannot be disposed of so easily.

Cases of progressive muscular wasting with involvement of face muscles, have always been considered rare. Duchenne described several, Remak Mossdorf, Bernhardt, Kreske, and Westphal, have each described one or two cases; but Landouzy and Déjérine (loc. cit.) have succeeded in calling renewed attention to this form, have made the most careful examinations, and have obtained a post-mortem examination in one case. For this reason it is just to refer to the features of this type as laid down

by Landouzy and Déjérine, who have seen more cases than all other recent authors taken together.

The Type Landouzy Déjérine.—This form of progressive muscular wasting begins, as a rule, in early life, and in the majority of cases in the muscles of the face, giving rise to what the authors term the "*facies myopathique.*" The lips are considerably thickened, and constitute the "*bouche de tapir.*" Great stress is laid upon this tapir-mouth appearance. Later on in the course of the disease the atrophy spreads to the shoulder and arm muscles; the supra and infra spinati, the subscapularis, the flexors of the hand and fingers remain normal. The muscles of deglutition, mastication, and respiratory and laryngeal muscles, as well as the ocular muscles, remain normal. In exceptional cases the disease may begin in the shoulder or arm muscles or even in the lower extremities. The disease is distinctly hereditary. Fibrillar contractions and reaction of degeneration are never present.

In their first paper, Landouzy and Déjérine published cases occurring in two different families; in the first the disease could be followed up through five generations. Cases that are described relate to a father and four sons, five other children not having been affected. The history of one son is characteristic.

The trouble began at the age of three with atrophy of face muscles; no other symptoms observed up to the age of 17. From that time on, atrophy was noticed in the muscles of the shoulder and arm, spreading to the trunk. At the age of 21, atrophy had become extreme—"nothing but skin and ¦bone"—*facies myopathique* and *bouche de tapir.* Sensation normal, sphincters also, patellar reflex lost, electrical excitability diminished in proportion to the wasting, but no reaction of degeneration. At the age of 24, death of phthisis.

Autopsy.—Atrophy determined as follows: frontalis, orbicularis palpebrarum, zygomatici, orbicularis oris, and buccinator of both sides (levator anguli oris normal), trapezius, deltoid (infra and supra spinati, subscapularis, teres major and minor normal) biceps, brachialis internus,

and coraco-brachialis, triceps, supinator longus and exten-
sor radialis (supinator brevis, flexor digitorum sublimis et
profundus normal), extensor pollicis longus and extensor
indicis (extensor digitorum communis, extensor digiti minimi,
extensor ulnaris normal), abductor longus and extensor
pollicis brevis slightly wasted, abductor brevis pollicis
wasted, other thenar and hypothenar muscles normal.
Lumbricalis distinctly wasted and interossei slightly wasted,
pectorals wasted, serrati and sacro-lumbar normal. Lower
extremities not so carefully examined ; glutei were atro-
phic ; no marked lipomatosis anywhere ; no changes in the
nervous system. Diseased muscles revealed simple atrophy
of primitive muscular fibres ; slight traces of increase of
interstitial connective tissue and of fat. No increase in
muscular nuclei.

The histories of the cases of Remak and of the other
authors quoted are very similar. In some the atrophy set
in in the extremities first, and in the face later on. In Re-
mak's case both sides of the face were involved ; in Kreske's
the one side only.

The similarity between this form and Erb's will be ap-
parent to every one at a glance ; it is practically Erb's form
plus involvement of face muscles. Erb never observed this
complication in his own cases, and Landouzy and Déjérine
argue that their cases are different on account of the ab-
sence of lipomatosis and the presence of facial symptoms.
As for Erb never having observed the facial atrophy in
any of his cases, it is worth noting that in a later paper
Landouzy and Déjérine publish a case (No. 6) of their form,
in which the face muscles appeared normal during life, but
on post-mortem examination revealed decided morbid
changes. It is possible, therefore, that the changes were
present in some of Erb's cases without so excellent an
observer as he being able to detect them. If this is allowed
(and the French authors themselves admit the possibility of
this), there is no just reason for making a separate type for
such cases as they describe. They deny the resemblance
between the two forms in consequence also of the invari-
able absence of lipomatosis ; but Westphal again seems to

have found a decisive case which shows that the face mus-
cles may be associated with typical pseudo-hypertrophy,
and it must be remembered that Landouzy and Déjérine
grant that they have found hypertrophied fibres in some of
the muscles. We cannot, therefore, see the propriety of
creating a separate type such as Landouzy and Déjérine
have described. There is a slight difference between their
cases and those of Erb in the topographical distribution of
the atrophy, and even this is doubtful; while their cases
resemble Erb's form in the involvement of the upper arm
and shoulder muscles chiefly, in the presence of hereditary
influences, in the absence of fibrillar contractions, and ab-
sence of reaction of degeneration.

I wish, however, to enter a special plea for the recog-
nition of still another type—*the peroneal type of progressive
muscular atrophy.*

This form was first described by Charcot and Marie
and, independently of them, by Dr. Tooth, of England,
in a Cambridge thesis. Charcot and his associate reported
five such cases, Tooth four cases, and Herringham has
recently reported one case in a family in which various
members in successive generations have been similarly
affected. To this list I am able to add one case of consid-
erable interest, and similar cases, although not designated
by this title, have been described by Hammond (Weathers-
bee ail), by Ormerod, by Schultze, and no doubt some
other of the cases of hereditary muscular atrophy would
more properly belong to this class.

This special form of progressive muscular atrophy be-
gins in early youth, or may, as in one of Charcot's cases,
attack a person beyond the age of puberty. It shows dis-
tinct family inheritance. According to Herringham, as a
rule, boys inherit the disease through the mother, as has
been shown to be the rule in cases of pseudo-hypertrophy.
The atrophy begins in the lower extremities, first attacking
the extensor hallucis longus, then the common extensors
of the toes, and then the peronei; the small muscles of the
foot may be affected as well. The calf muscles atrophy a
a little later, while the muscles of the thighs offer greater

resistance and do not undergo atrophy until the disease has
well run its course. Several years after the onset of the
disease in the legs, the hands become involved; the inter-
ossei, the muscles of the thenar and hypothenar, as well as
the muscles of the forearm become wasted; the muscles of
the shoulder, of the neck, trunk, and face remain normal.
The atrophy need not be entirely symmetrical. Fibrillar
contractions occur occasionally; the reaction of degeneration
is present in some muscles; the skin reflexes remain nor-
mal.

My own case is as follows:

R. J., a Russian girl, aged 12, was referred to my depart-
ment at the Polyclinic by Dr. Gibney. She is the third
child of healthy parents; two born later died, one of diph-
theria, and one of cerebral trouble after a fall. No disease
similar to the one from which this patient suffers has been
known in any branch of the family. While carrying this
child, the mother was considerably troubled with swollen
feet and legs, possibly of nephritic origin, but is now a
healthy, stout woman. The child was asphyxiated when
born; no doctor in attendance. Patient began to walk at
nine months; had a slight fall at the age of ten months
without doing any injury to herself. At the age of three,
mother noticed that there was something wrong with the
right knee, and in the hospital at St. Petersberg a plaster
of Paris splint was put on. This the child wore for seven
weeks. She could walk perfectly well after that, played as
well and ran as fast as any child. Has had a number of
diseases—measles at the age of one year, small-pox at the
age of four, scarlet fever at six, typhoid fever at six and a
half. In spite of all, recovered and walked perfectly well.
Came to this country one year ago; nine months ago fell
on left hip, and for some weeks had pain in left hip. While
recovering from this fall, she noticed that she had difficulty
in moving the toes of the right leg. This is now five months
ago. The impairment of motion gradually grew worse until
the child was not able to move the toes at all. Never had
pain on her right side. Her present manner of walking
developed very slowly. At first sight her gait seemed to

be characteristic of poliomyelitis. Child complains of fatigue, particularly in mounting stairs ; no other special symptoms. Patient was a bright girl ; no hysterical tendencies. The history shows that the present condition of paresis developed slowly and was not preceded either by convulsions or fever ; furthermore, that there was no pain accompanying the paresis at any time. Has distinct feeling of movement under the skin.

Examination.—Girl of medium size. Upper extremities, good grasp with both hands 43. Forearm muscles and hand muscles well developed ; supinators, also biceps and deltoids well marked, the latter not hypertrophied. Trapezii and rhomboids of normal strength ; right pectoral a little thinner than left. Right shoulder blade shows slight winged appearance. Right serratus slightly weakened. Distinct wasting of the right leg, thigh, and of the right gluteal region. The leg muscles of the right side more distinctly atrophied than the thigh muscles. The child cannot lift toes of right foot while resting the heel on the ground. The same movement can be performed fairly well on the left side. Cannot raise herself on tiptoes on the right side, but can do so with the left foot. Posterior surfaces of thighs proportionately less developed than anterior surface. Right extensor quadriceps very weak ; left weaker than normal, but stronger than on right side. Evident atrophy, therefore, of anterior tibial and posterior tibial group of right leg, of posterior thigh muscles and the glutei muscles of right side. In the lying position, 10 centimetres below lower edge of the patella, right leg, 23½ cm.; left leg, 24½ cm.; 18 centimetres below iliac, right thigh, 37 cm.; left thigh, 39 cm.

Knee-jerk absent on right side ; on left side it was impossible to obtain the knee-jerk for several weeks ; it is now present, however, and very lively. Occasional fibrillar contractions. No sensory disturbances anywhere. No rectal or visceral symptoms. The triceps tendon reflex present on both sides, but weak. Occasional fibrillar contractions have been noticed.

Electrical Examination.—Faradic examination of all nerves and muscles gives satisfactory responses except in the case of the right peroneal nerve which exhibits diminished faradic excitability. On faradic excitation of peroneal nerve, tibialis anticus muscle contracts very feebly. Serratus also responds more powerfully on the left side than on the right to current of moderate strength. Left pectoralis major does not respond as well as right to faradic current. Galvanic examination satisfactory. The following alone need be mentioned. Examination with the 10 ctm. square electrode : Right peroneal nerve, KCC, 2¼ ma.; AOC, 3½ ma.; ACC, 6½ ma. Left peroneal nerve, KCC, 2½ ma.; AOC, 3½ ma.; ACC, 6¼ ma. Right tibialis anticus muscle, direct examination, KCC, 7 ma.; ACC, 8 ma. Left tibialis anticus, KCC, 4½ ma.; ACC, 6 ma. Electrical examination thus shows a decided diminution of response to the faradic current, and to the galvanic current as well in the tibialis anticus of the right side, the KCC being almost equal to the ACC. Ormerod would have said that the peroneal nerve showed reaction of degeneration with regard to the anode, but this, I insist, is nothing morbid. We have, therefore, slight electrical changes in a single muscle ; the other muscles of the peroneal group respond normally.

The diagnosis in this case could have rested only between acute anterior poliomyelitis, a peripheral neuritis, or this form of progressive muscular atrophy. The mode of onset, gradually and without pain, without fear or convulsions, argues against a poliomyelitis anterior acuta, as well as against peripheral neuritis. The atrophy, too, is not as great as we would expect in a case of spinal infantile palsy. All of the symptoms—the paralysis proportionate to the wasting of the muscles, the absence of the knee-jerk, and the slight changes in electrical reaction can be best explained by the diagnosis we have made. Furthermore, the disease is not retrogressive as poliomyelitis acuta would be, but gradually progressive, and the slight indications of this progression in the muscles of the trunk lend further support to the view of a progressive muscular atrophy, which

is strengthened still more by the occasional presence of fibrillar contractions.

The diagnosis in such cases as these must be made with the greatest care, but I have no doubt that some of the cases which have hastily been put down as cases of peripheral neuritis will prove to be cases of this type. From poliomyelitis anterior acuta it will not be difficult to differentiate this disease, nor from neuritis. It will be more difficult to distinguish between these cases and those of a widespread atrophy following traumatic joint lesions, in which, as I have seen a number of times, the atrophy may spread with surprising rapidity and may affect the entire extremity. We must, therefore, either rely upon the history in these cases, upon the presence or absence of fibrillar contractions, or must exclude a purely traumatic atrophy in case the atrophy jumps from the affected part to some other portion of the body.

In many cases of progressive muscular atrophy of the typical form, the histories show that the disease was first noticed after some accident. The question, therefore, arises, whether it may not be possible for a typical progressive muscular atrophy to develop after a joint lesion in a subject predisposed to this disease.

We have now to consider the relations of this peroneal form of progressive muscular atrophy to the other primary dystrophies which we have discussed.

It will be seen at once that the anatomical distribution is entirely different from the four forms of primary myopathies discussed above. If the atrophy spreads to the upper extremities, it involves the muscles more after the fashion of a Duchenne's atrophy than after the fashion of a pseudo-hypertrophy or an Erb's form of atrophy. The analogy to Duchenne's form becomes still closer when we consider that this peroneal form is distinguished from the other myopathies by the occasional presence of fibrillar contractions and by alterations in the reaction of degeneration. The spreading of the atrophy from the muscles of the big toe and the small muscles of the foot to the muscles of the legs and thighs reminds one of the manner in

which the atrophy spreads in the upper extremities in cases of typical progressive muscular atrophy. There seems, therefore, to be good reason to separate this form from the simple muscular myopathies and to make it a subdivision of typical progressive muscular atrophy. This form might be properly entitled the leg type, in contradistinction to the hand type which would represent the ordinary form of Duchenne's progressive muscular atrophy.

If the ordinary progressive muscular atrophy is a polio-myelitis anterior chronica cervicalis, the leg type might represent a poliomyelitis anterior chronica lumbalis. But this is speculative pathology and needs corroboration, as indeed all the clinical and anatomical features of this form do.

In the preceding pages I have given an account of the commonly received forms of progressive muscular wasting. Some cases will surely be found that cannot properly be classed under any one of these heads. Schultze's case, for instance, had some of the features of pseudo-hypertrophy, some of those of Erb's form, and in the presence of the fibrillar contractions and reaction of degeneration in some muscles approached to the type of typical progressive muscular atrophy. I have had occasion to observe one case in a child about seven years of age in which there was a general wasting of all the muscles of the body excepting those of the head. The power of the legs and arms was weak, without there being any actual paralysis. There was a winged appearance of the scapulæ, but there were no other disproportionate atrophies or hypertrophies anywhere in the body. The wasting was an entirely uniform one. Such a case as this one is mentioned by Charcot in his recent volume and by Gowers in his text-book. Baeg (loc. cit.) and Oppenheim have reported cases with involvement of the face, tongue, laryngeal and ocular muscles, which it is impossible at present to classify under any of the ordinary forms of progressive muscular atrophy.

There is good reason, therefore, for allowing that there are mixed cases of progressive muscular atrophy, and that the exact rank of these cases cannot be determined at pres-

ent, except that according to their cardinal symptoms, they should be classed either with the spinal or primary myopathies.

The study of the histological changes in the various forms of progressive muscular atrophy is omitted in this abstract.

From .the survey of the histological researches in various forms of muscular atrophy, we conclude that an examination of muscular changes may help us to differentiate between typical progressive muscular atrophy and the primary myopathies; and again, if Hitzig be correct, between pseudo-hypertrophy and Erb's juvenile form. There does not, however, appear to be a marked distinction between Erb's juvenile form and the remaining primary dystrophies, the histological changes in the peroneal form being still undetermined.

The argument which has been held throughout these pages leads to the following conclusions:

1. Progressive muscular atrophy, type Aran-Duchenne, is due to spinal cord disease. The peroneal type of progressive muscular atrophy bears close resemblance to this form and may possibly have a similar pathology.

2. Duchenne's type of progressive muscular atrophy might be termed the hand type, while the peroneal form would represent the leg type.

3. Pseudo-hypertrophy is not of spinal origin. Lipomatosis is a mere incident in the course of the disease, and is associated with wide-spread atrophy in various parts of the body.

4. There is a close relationship between pseudo-hypertrophy and Erb's juvenile form of progressive muscular atrophy, but not an absolute identity. This close relationship is marked by the onset of the disease at an early age, by its occurrence in various members, of a family by the entire absence of fibrillar contractions in both forms, by the absence of reaction of degeneration, and by the occurrence of lipomatosis some time during the course of the disease. They differ from each other in the distribution

of atrophied muscles and possibly in their histological conditions.

5. Hereditary muscular atrophy does not deserve the rank of a separate clinical entity, all forms of primary myopathies being occasionally hereditary.

6. The type Landouzy and Déjérine is closely related to Erb's form, the additional involvement of the face muscles not being a sufficient basis for a marked clinical differentiation.

7. Pseudo-hypertrophy and Erb's form should be regarded as the two representative forms of primary progressive dystrophies.

8. Primary progressive dystrophies are distinguished from spinal progressive dystrophies by their cardinal symptoms—the onset at an early age, the occurrence of true or false hypertrophy, the absence of the reaction of degeneration, and the absence of fibrillar contractions.

This paper cannot be properly closed without reference to the subject of classification. The term "progressive muscular atrophy" has been variously used both to designate the fact of a general and progressive muscular wasting, and also as to the proper name for Duchenne's type of atrophy. This has led to great confusion, and it would be well if the term "progressive muscular atrophy" were to be used in a generic sense merely, and if some other name were found for Duchenne's type. Erb's suggestion seems to me to be a good one, and I therefore propose to designate the type Aran-Duchenne as spinal progressive amyotrophy.

If my argument against the validity of anatomical distribution of atrophies or hypertrophies as a basis for classification be accepted, the classification of muscular atrophies could be reduced to the following simple form :

 1. Amyotrophia spinalis progressiva ;
    a. Hand type ;
    b. Leg type = peroneal form.
 2. Primary progressive dystrophies ;
    a. Pseudo-hypertrophy ;
    b. Erb's form.

DISCUSSION ON DRS. JACOBY AND SACHS' PAPERS.

DR. P. C. KNAPP distinguished between the primary and the secondary myopathies. There was hypertrophy of the fibres in the former and atrophy of the fibres in the latter. The primary process in primary muscular dystrophies was not the chronic interstitial inflammation. The increase of nuclei in the fibre indicated an inflammatory process, and it was more in accord with our present idea of these degenerations to suppose that this was primary and the interstitial change secondary. This would reduce the process to the type of similar degenerations in the liver and kidneys and in the cord, in tabes, Similar degenerations might affect the cortex, perhaps; the spinal motor tract, possibly; the peripheral motor nervous mechanism, certainly; and also the muscles. The primary myopathies of the muscles were analogous to the changes in other parts of the motor tract.

I think that we could yet divide clinically cases into those of peripheral or central origin. Dr. Sachs had said that there were no fibrillary contraction in the former. When the speaker returned to New York he would be glad to show him a case in which there were such fibrillary contraction. Even pseudo-muscular hypertrophy was mixed with atrophy. He thought it wiser to acknowledge no conclusions rather than to adopt false conclusions, even though they should be those of Dr. Erb.

DR. W. A. HAMMOND, in reply to Dr. Sach's criticism of his book stated that the first edition of this book was written eighteen years ago, and the last edition four years ago. It was therefore hardly fair to bring him into court for any conclusions therein contained. He did not agree with the trenchant manner in which the author had dismissed the harpoon. All we knew upon the subject had been obtained by means of the harpoon. It was easier to criticise than to experiment. Later he might accept the classification presented, but for the present he would not change, but would sustain the position of Dr. Gray.

DR. G. L. WALTON referred to a case of the peroneal type and yet myopathic in origin. Heredity was traced into the beginning of the seventeenth century. The patient was 62 years of age, and had been affected for twenty years. Her mother had died at 87, having been affected since her thirty-fifth year.

DR. J. J. PUTNAM reported a case of hereditary dystrophy, in which there were no gross signs of pseudo-hypertrophy but the microscope showed hypertrophic as well as atrophic fibres. Specimens were exhibited.

DR. SACHS reminded Dr. Hammond that he had been appointed to open the discussion, and hence had had to assume a critical attitude. He had only intended to make the broad distinction between spinal and primary. The presence or absence of fibrillary contractions and of the reaction of degeneration were important and had distinct bearing upon the differential diagnosis.

Dr. GEORGE W. JACOBY.—In discussing this subject of primary myopathies, a subject which during the last few years has received so much attention at the hands of competent observers, and of which the present state of our knowledge has been so thoroughly and ably set forth today, it would almost seem that personal views and opinions only, can be given by each participant, as American literature upon the subject is very scant, this being due to a great extent to the rarity of certain "types" in this country. This, at any rate, has been my own experience; for, outside of cases of pseudo-hypertrophic paralysis in its various stages, and some cases in which the myopathic origin was doubtful, I have seen little.

I can only consider it a misfortune that the tendency has for so long a time been to subdivide the muscular atrophies more and more, not resting content with a simple division into spinal and primary muscular form, but also to subdivide these latter, until every deviation from the so-called

typical course must needs receive a special designation and be looked upon as a special form of muscular disorder, with the gratuitous hypothesis by some that each special form is dependent upon a special cause.   This tendency has happily during the last few years, owing to the efforts of Charcot and Erb, received a decided check, so that to-day only can we say that we are on the right path towards a correct comprehension of the subject.   How much still remains to be decided is shown by the fact that even the fundamental division into spinal and muscular forms cannot in all cases be sharply made.   The possibility of this division has been considered unassailable ; and, although it cannot be denied that there are many cases in which we can at once say that they are purely spinal, many others that are purely muscular, still there are two classes of cases which under certain circumstances may make the differentiation as to their spinal or muscular character impossible during life.   The cases to which I refer are, first, those in which there are no distinct nervous systems, in which there is no heredity, which show neither hypertrophy nor pseudo-hypertrophy, begin in the shoulder muscles, and occur in adults.   The second class consists of the type described by Charcot and Tooth as peroneal, and here I include also the cases of Schultze published in 1884.   Schultze is perhaps more justified in considering his cases peripheral than is Tooth ; for, in the cases of the former observer, fibrillary twitchings were absent. Whether these cases are really of peripheral origin, as assumed, is a question upon which I have my serious doubts. The difficulty in separating the just-mentioned forms becomes apparent when we consider that fibrillary twitchings and reaction of degeneration have also been found to be present in certain purely muscular forms.

If then we have trouble at the very beginning of our classification, how much more difficult will it be to prove that the various forms of primary myopathic disorders are really different "types," and not simply variations in the localization of one and the same process.   It seems to me, from all we now know, that if we take into consideration the published cases of the juvenile and of the pseudo-hyper-

trophic form, each with involvement of the facial muscles;
Duchenne's infantile forms now considered neuropathic,
varying to such an extent that they as often show the juven-
ile as the pseudo-hypertrophic character; cases of pseudo-
hypertrophy which later show a complete picture of Erb's
juvenile form; cases of pseudo-hypertrophy occurring in
adults, and classed under the juvenile form by Erb; finally,
the various forms occurring in one and the same family
(Zimmerlin, Barsickow),—considering these facts, I believe
that we must admit a clinical entity, that all these so-called
types are simply fortuitous localizations of one affection, no
matter in what light the process itself may be considered.
The difficulty in understanding these myopathies is, how-
ever, not solely due to the varying clinical characteristics,
but also to our lack of definite knowledge regarding the
minute muscular changes,and on account of the darkness
surrounding their pathogenesis.   Microscopically, we find a
coincidence of appearances which can only fortify our posi-
tion as regards the unity of the various forms.   Muscular
examinations have been confined chiefly to cases of pseudo-
hypertrophy, under which I include Schultze's very com-
plete examination of his atypical case, and the case of
infantile muscular atrophy by Landouzy and Déjérine
(Revue de Méd., 1888).   In addition to this, muscular ex-
aminations of the juvenile form have been made by Erb and
Hitzig during the last few years.   In all these examinations
attention has been mostly given to the changes found in the
connective tissue, and the changes in the muscles themselves
have been very much neglected; the only differences found
in the various forms being that now the formation of fat
or proliferation of connective tissue preponderates, now
there is simple atrophy in the muscular fibres, and again, in
other cases, waxy, fatty, or fibrous degeneration.

    More or less the same changes are always seen by vari-
ous observers in the various cases, but the interpretation of
that which is seen is not always the same.   It would seem
that the only reliable differential point, microscopically,
between muscles from the spinal and those from the muscu-
lar forms lies in the presence or absence of hypertrophic

fibres.   That is to say, the presence of hypertrophic fibres always excludes the spinal origin of the disease, the absence, however, of such fibres not proving anything, as shown by my case of pseudo-hypertrophy published last year.   I myself do not believe that this test is always reliable, particularly in view of a case recently published by Hitzig.   This case was one which began with paraesthesias and was followed by loss of use of the upper extremities through atrophy in a year and a quarter.   Finally symptoms of severe irritation occurred, cramps and extended muscular twitchings with increased reflexes.   The periosteal reflexes of the lower extremities and the patellar tendon reflexes were very much increased.   This case, which I think we all would diagnose as spinal, Hitzig diagnoses as muscular, for the only reason that he found hypertrophic fibres present microscopically.

I think that, allowing the diagnosis between the spinal and muscular seat of the affection to depend entirely upon a single symptom, is going entirely too far, particularly when the clinical symptoms are at variance with that which we are accustomed to see.   Now, as regards the microscopical changes found in the muscles, we must, I think, differentiate between the processes which seem to occur either alone or together.   These processes are primarily degeneration and inflammation, processes which, in my opinion, to a great extent determine the clinical symptoms and course of the disease.   It would appear, *a priori*, that, in examining muscular tissue microscopically, there ought not to be any difficulty in deciding what is inflammatory and what is degenerative.   As far as the changes produced by acute inflammation are concerned, I think no one will doubt the possibility of diagnosing this process microscopically.   My paper on polymyositis presented to-day clearly illustrates that.   In my specimens of this case we can trace the process almost step by step.   We have here, referring to the muscular fibre itself, a proliferation of nuclei in the body and at the periphery of the fibre, without any change being observed in the surrounding contractile matter.   These nuclei increase until we have the appearance of a giant cell, the

sarcolemma being still present. Then the muscle fibre breaks up into indifferent or medullary corpuscles, some of which are still nucleated. The sarcolemma sheath is now indistinct, and it is difficult to clearly separate the muscle fibre from the adjacent perimysium, which also is largely composed of similar bodies. In other places we see the process commencing, not by the appearance of nuclei in the body of the fibre, but by a breaking up *in toto* of the fibre into clusters and lumps, these then growing up to the size of nucleated medullary corpuscles.

These are changes which we see in all tissues when acute inflammation occurs, as also in secondary inflammation of the muscles from the various causes enumerated in my paper.

But when we come to the later stages—the products of the acute inflammation—then it is truly difficult to say whether we are dealing with products of inflammation or with primary degenerative processes. Every one will, however, admit that if by the side of the acute inflammation I see changes which are similar to degenerative changes, I am warranted in concluding that these changes are not primary, but are the results of the inflammation.

Unfortunately all our cases of chronic primary myopathies show little or nothing of the acute stage when the microscopical examination is made, and therefore we stand before such processes as "proliferation of connective tissue," "simple atrophy," "waxy degeneration," "fatty degeneration," without being able in each individual case to say, Is this a primary process, or is it the result of an inflammation? While now I would not go as far as Friedreich and consider every case inflammatory because an increase of nuclei is present, still I think that if I am able to show that an acute inflammation of the muscles can produce changes identical with those observed in the chronic myopathies, it is not unreasonable to suppose that some of these myopathies may be of inflammatory origin. Clinically, also, cases have been described of pseudo-hypertrophic paralysis with cure, which, in my opinion, can only be understood upon the hypothesis of an acute myositis (Donkin, Brit. Med. Jour.,

1882, I., p. 537 ; Fawsitt, Lancet, 1887, II., p. 158). Particularly is this the case in Fawsitt's case, which presented muscular pains preceding the symptoms of the pseudo-hypertrophy.

Even Gowers concurs in the opinion that this is a true case of pseudo-hypertrophic paralysis. Now, I personally cannot conceive of a complete regeneration in a primary degenerative process, but I can easily believe that we have here an inflammation which has stopped short of degeneration.

It seems to me probable that these primary muscular affections, including progressive myositis, myositis ossificans, and also Thomsen's disease, are all due to an embryonal malformation (shown in my case to-day by the small size of all the fibres), a malformation of the muscle plate rendering the future muscles particularly susceptible to pathogenic influences. What these influences are can of course not be stated ; they need, however, not be physical in character, but may be chemical, due to atmospheric influences, etc. This tendency to disease will in one patient or family localize itself in that group of muscles which is most inhibited in its development. That even gross defects in the development of the muscular system occurs is shown by the fact that the latissimus dorsi and lower half of the pectoralis are sometimes congenitally absent in cases of pseudo-hypertrophic paralysis. What form the disease will take will, in my opinion, depend entirely upon the cause of production ; and if this be chemical or atmospheric (infectious), the probabilities are that it will begin as a myositis ; if due to other causes, dependent perhaps upon an altered influence of the nervous system, then we will have a primary degeneration. I cannot conceive of a primary degeneration independent of nerve influences. Any further remarks which I might be inclined to make in this direction would only be a repetition of statements already made in my paper on polymyositis.

Dr. L. C. GRAY stated that, while pseudo-muscular hypertrophy was probably of peripheral origin, he thought the question was still open to doubt. He referred to Gibney's and Amidon's cases.